

# Lecture 1

Introduction

Collections

# Data structures and Algorithms

- A computer program is a sequence of instruction that works on data to produce a desired result (Operations done on Data)
  - A set of computer instructions in a specific language, or even described generally using **flowcharts** or **pseudocode** , are called an algorithm.
  - Data structures are containers of data used to store the data while being processed by algorithms

# Basic data types and data structures

- All high level programming languages provide basic data types to store basic data values
- Examples are int, float, double, and char in C
- Almost all language provide the most common data structure: Arrays which are used to store a collection of similar data
- What can we do if we need a special data structure? Or when we need that data are stored and retrieved in in a specific manner (queue for example)
  - Use the available data structure (array) as a queue, but be careful when putting and retrieving the data
  - Build, or use an already available, data structure designed exclusively to be used as a queue
  - Which is better? and why? (consider user safety and team working)

# What we will study

- Data structures
  - Specially designed data structure
  - Data structures comparisons
  - How to employ ready to use specially designed data structure in problem solutions
  - Design and implementation of special data structures
- Algorithms
  - Algorithms for common computer tasks
  - Algorithms evaluation and comparisons
  - Employing common algorithms to solve problems

# Which language?

- C sharp or C++
- What is C Sharp
  - Just clean and managed C
- Why C Sharp
  - Application programming is usually done using managed language and Virtual machine
  - C Sharp is just the C you studied but with some simplification and manageability

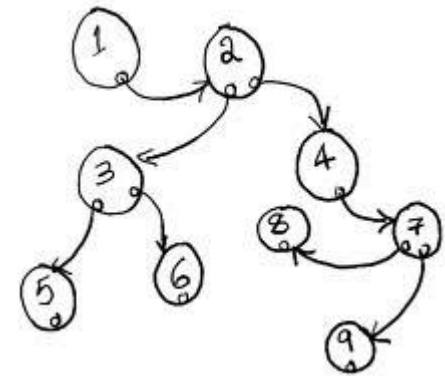
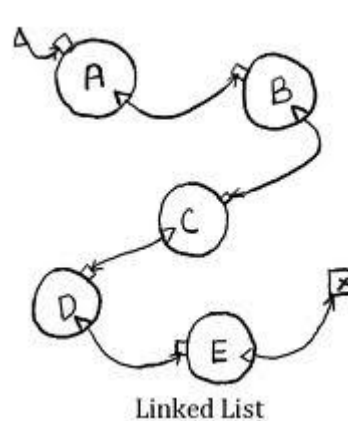
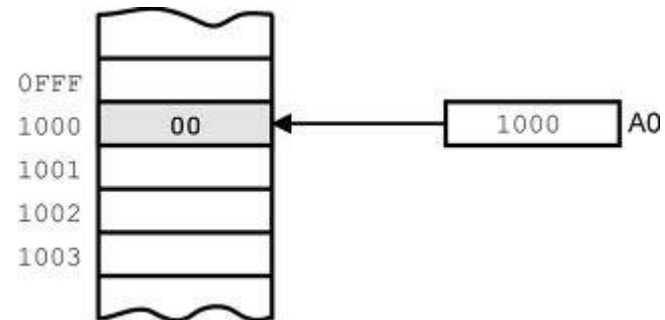
## Data Collections

A collection is a structured data type that stores data and provides operations for adding data to the collection, removing data from the collection, updating data in the collection, as well as operations for setting and retrieving the values of different attributes of the collection.

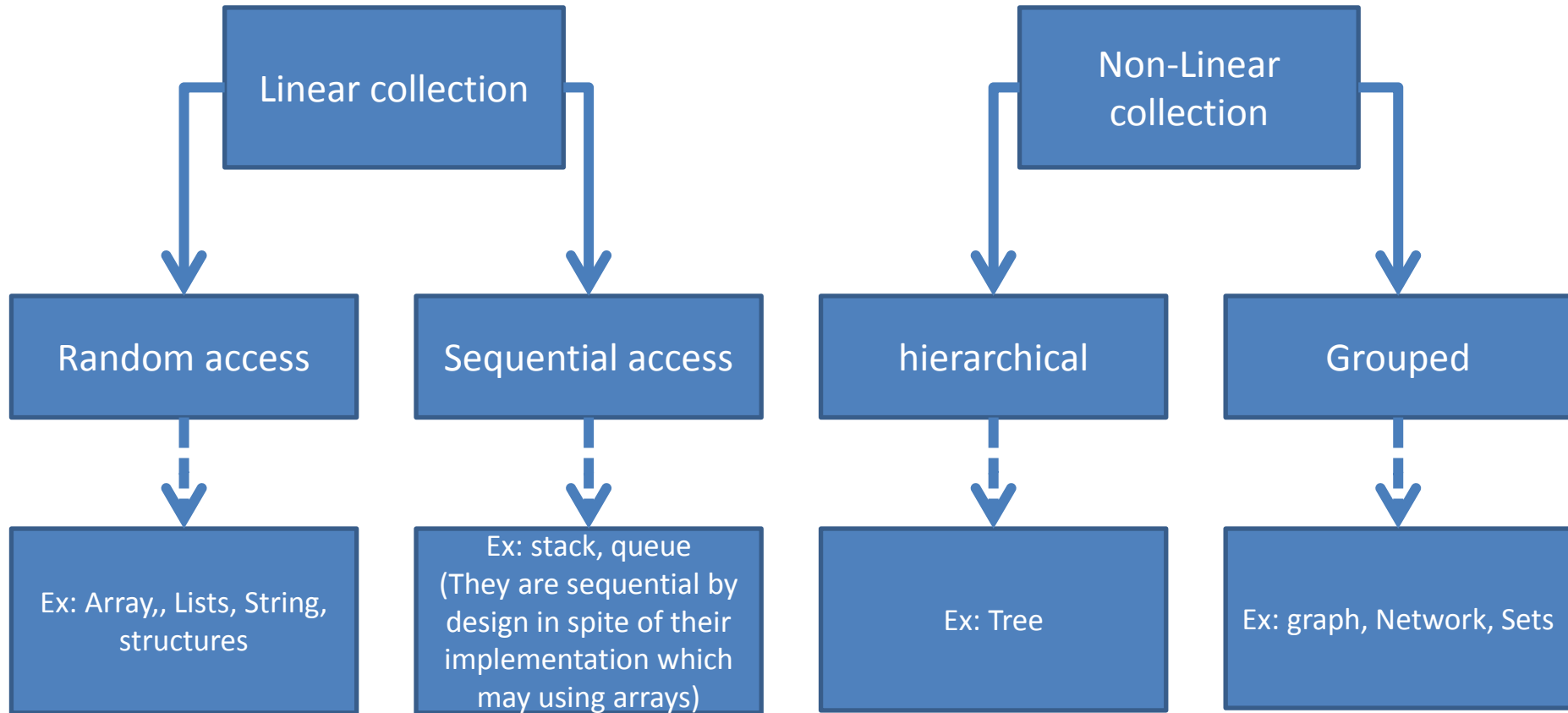
A collection May be Linear or nonlinear

A linear collection contain elements that have positional order(list of pens)

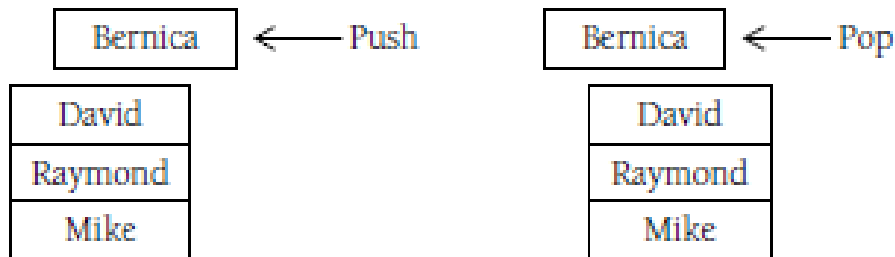
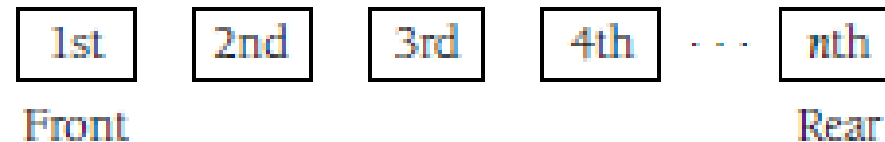
A nonlinear collection contains elements that have no positional order (organization chart)



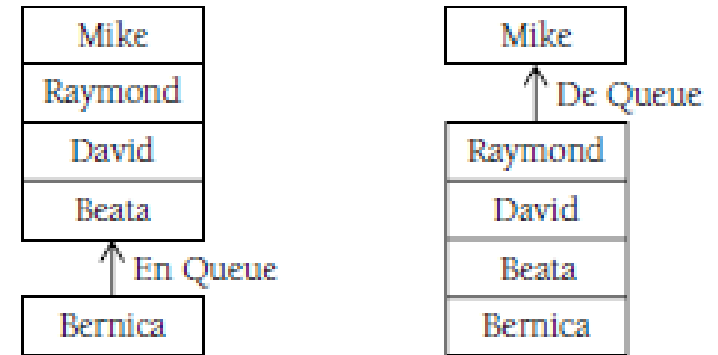
# Collection categories



# Common Linear lists



A stack is a list where access is restricted to the beginning (or top) of the list. Items are placed in the list at the top and can only be removed from the top. For this reason, stacks are known as Last-in, First-out (LIFO) structures.



A queue is a list where items are added at the rear of the list and removed from the front of the list. This type of list is known as a First-in, First-out (FIFO) structure.



# Common Linear lists

## A Record To Be Hashed

"Paul E. Spencer"
37500
5
"Information Systems"

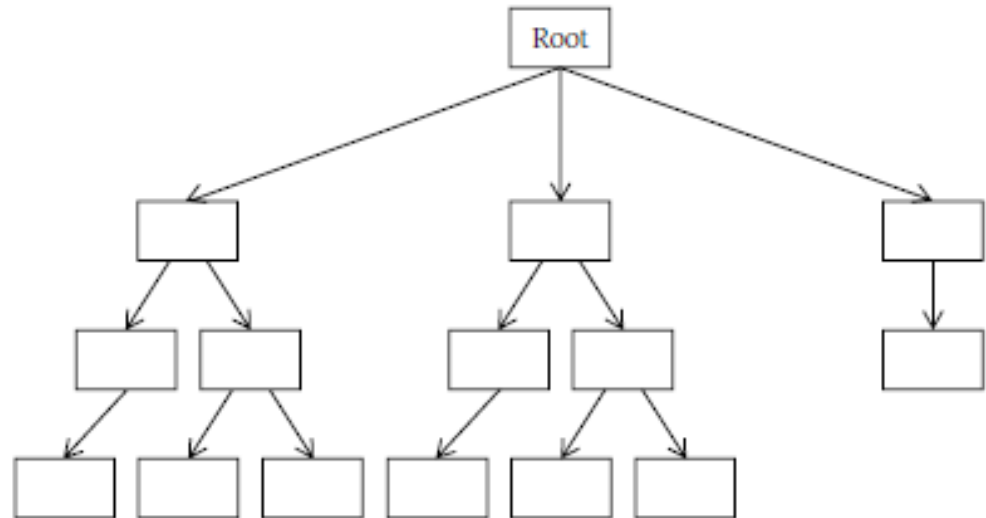
A hash table, stores a set of data values associated with a key. When adding a value-key pairs in a hash table, a special function, called a hash function, takes the key and calculates a hash code from it. That code is used to directly retrieve the data at any time later.

The .NET 1.0 provided the Hashtable class that uses the object data type as values and keys. Version 2.0 .NET provided it's type safe version of the Hashtable called **Dictionary <T1 key, T2 Value>**. New application should always use the Dictionary but not the Hashtable

# Common nonlinear lists: Tree

A hierarchical collection is a group of items divided into levels. An item at one level can have successor items located at the next lower level

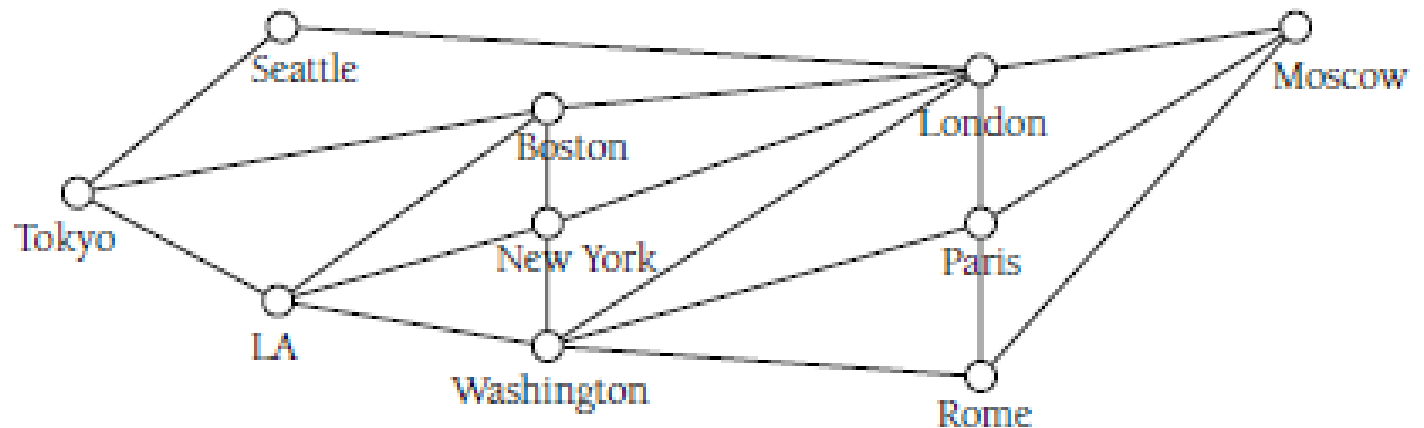
Hierarchical Collections



A tree collection looks like an upside-down tree, with one data element as the root and the other data values hanging below the root as leafs. The elements of a tree are called nodes, and the elements that are below a particular node are called the node's children.

# Common nonlinear lists: Graph

Group Collections

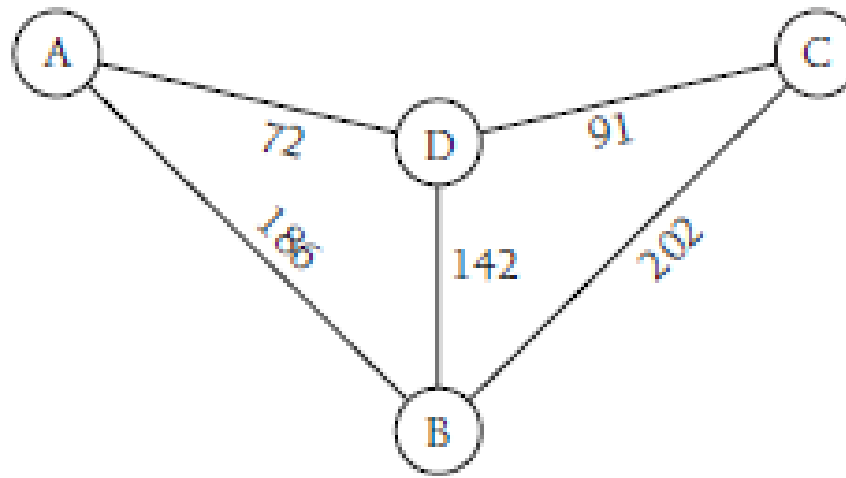


A nonlinear collection of items that are unordered is called a group. The three major categories of group collections are sets, graphs, and networks.

A graph is a set of nodes and a set of edges that connect the nodes. Graphs are used to model situations where each of the nodes in a graph must be visited, sometimes in a particular order, and the goal is to find the most efficient way to “traverse” the graph.

# Common nonlinear lists: Network

Group Collections



A network is a special type of graph where each of the edges is assigned a weight. The weight is associated with a cost for using that edge to move from one node to another

# Report Discussion

Last lecture report: None

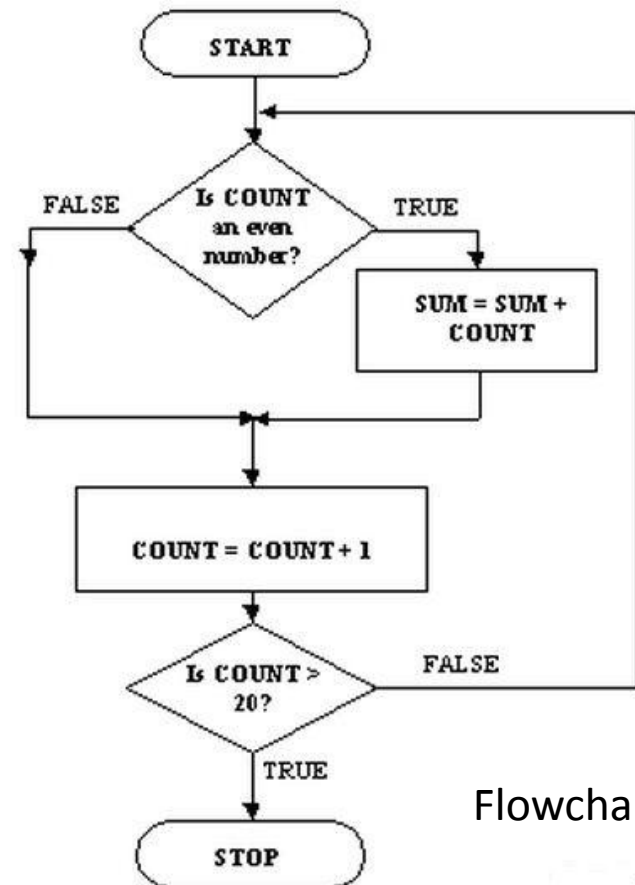
New report: Find out in your surrounding world some application that may need special data structures to automate them using computers. Which data structure you will use for each application ? why?

# Describing an algorithm

Step 1 initialize:  $\text{sum}=0$ ,  $\text{count}=0$ ;  
Step 2 if count is even  
    then  $\text{sum}=\text{sum}+\text{count}$   
Step 3 Increment count  
Step 4 if  $\text{count} \geq 20$   
    then stop  
    else go to step step 2

pseudocode

## Add even number



Flowchart